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December 2013

# 74LCX244 Low Voltage Buffer/Line Driver with 5V Tolerant Inputs and Outputs

#### **Features**

- 5V tolerant inputs and outputs
- 2.3V to 3.6V V<sub>CC</sub> specifications provided
- 6.5ns  $t_{PD}$  max.  $(V_{CC} = 3.3V)$ ,  $10\mu A I_{CC}$  max.
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal<sup>(1)</sup>
- $\pm 24$ mA output drive ( $V_{CC} = 3.0$ V)
- Implements proprietary noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Leadless DQFN package

#### Note:

 To ensure the high-impedance state during power up or down, OE should be tied to V<sub>CC</sub> through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

#### **General Description**

The LCX244 contains eight non-inverting buffers with 3-STATE outputs. The device may be employed as a memory address driver, clock driver and bus-oriented transmitter/receiver. The LCX244 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX244 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

# **Ordering Information**

Order Number	Package Number	Package Description
74LCX244WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX244SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX244BQX <sup>(2)</sup>	MLP20B	20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
74LCX244MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCX244MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

#### Note:

2. DQFN package available in Tape and Reel only.

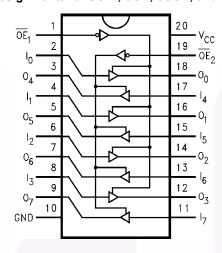
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.



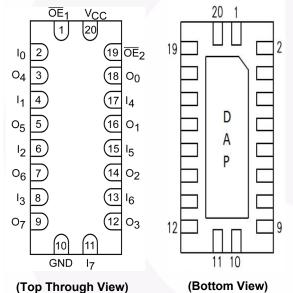
All packages are lead free per JEDEC: J-STD-020B standard.

#### **Connection Diagram**

Pin Assignments for SOIC, SOP, SSOP, and TSSOP



#### Pad Assignments for DQFN

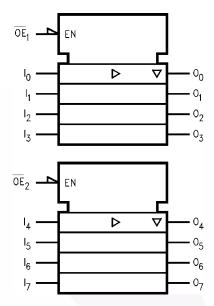


# **Pin Description**

Pin Names Description		
$\overline{OE}_1, \overline{OE}_2$	3-STATE Output Enable Inputs	
I <sub>0</sub> –I <sub>7</sub>	Inputs	
$\overline{O}_0 - \overline{O}_7$	Outputs	
DAP	No Connect	

Note: DAP (Die Attach Pad)

# **Logic Diagram**



#### **Truth Tables**

Inputs		Outputs		
OE <sub>1</sub>	I <sub>n</sub>	(Pins 12, 14, 16, 18)		
L	L	L		
L	Н	Н		
Н	Х	Z		

Inputs		Outputs
OE <sub>2</sub>	I <sub>n</sub>	(Pins 3, 5, 7, 9)
L	L	L
L	Н	Н
Н	Х	Z

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

Z = High Impedance

#### **Absolute Maximum Ratings**

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
V <sub>CC</sub>	Supply Voltage	-0.5V to +7.0V
V <sub>I</sub>	DC Input Voltage	-0.5V to +7.0V
V <sub>O</sub>	DC Output Voltage	
	Output in 3-STATE	-0.5V to +7.0V
	Output in HIGH or LOW State <sup>(3)</sup>	-0.5V to V <sub>CC</sub> + 0.5V
I <sub>IK</sub>	DC Input Diode Current, V <sub>I</sub> < GND	-50mA
I <sub>OK</sub>	DC Output Diode Current	
	$V_O < GND$	–50mA
	$V_{O} > V_{CC}$	+50mA
I <sub>O</sub>	DC Output Source/Sink Current	±50mA
I <sub>CC</sub>	DC Supply Current per Supply Pin	±100mA
$I_{GND}$	DC Ground Current per Ground Pin	±100mA
T <sub>STG</sub>	Storage Temperature	−65°C to +150°C

#### Note:

3. IO Absolute Maximum Rating must be observed.

# Recommended Operating Conditions<sup>(4)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Units
V <sub>CC</sub>	Supply Voltage			
	Operating	2.0	3.6	V
	Data Retention	1.5	3.6	
V <sub>I</sub>	Input Voltage	0	5.5	V
Vo	Output Voltage			
	3-STATE	0	5.5	V
	HIGH or LOW State	0	V <sub>CC</sub>	
I <sub>OH</sub> / I <sub>OL</sub>	Output Current			
	$V_{CC} = 3.0V - 3.6V$		±24	mA
	V <sub>CC</sub> = 2.7V–3.0V		±12	P
	V <sub>CC</sub> = 2.3V–2.7V		±8	
T <sub>A</sub>	Free-Air Operating Temperature	-40	85	°C
Δt / ΔV	Input Edge Rate, $V_{IN} = 0.8V-2.0V$ , $V_{CC} = 3.0V$	0	10	ns/V

#### Note:

4. Unused inputs must be held HIGH or LOW. They may not float.

#### **DC Electrical Characteristics**

				$T_A = -40$ °C	to +85°C	Units
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	Min.	Max.	
V <sub>IH</sub>	HIGH Level Input Voltage	2.3–2.7		1.7		V
		2.7–3.6		2.0		
V <sub>IL</sub>	LOW Level Input Voltage	2.3–2.7			0.7	V
		2.7–3.6			0.8	
V <sub>OH</sub>	HIGH Level Output Voltage	2.3–3.6	$I_{OH} = -100\mu A$	V <sub>CC</sub> - 0.2		V
		2.3	$I_{OH} = -8mA$	1.8		
		2.7	$I_{OH} = -12mA$	2.2		
		3.0	$I_{OH} = -18mA$	2.4		
			$I_{OH} = -24mA$	2.2		
V <sub>OL</sub>	LOW Level Output Voltage	2.3–3.6	$I_{OL} = 100 \mu A$		0.2	V
		2.3	$I_{OL} = 8mA$		0.6	
		2.7	I <sub>OL</sub> = 12mA		0.4	
		3.0	I <sub>OL</sub> = 16mA		0.4	
			$I_{OL} = 24mA$		0.55	
l <sub>l</sub>	Input Leakage Current	2.3–3.6	$0 \leq V_I \leq 5.5V$		±5.0	μA
I <sub>OZ</sub>	3-STATE Output Leakage	2.3–3.6	$0 \le V_O \le 5.5V$ , $V_I = V_{IH} \text{ or } V_{IL}$		±5.0	μΑ
I <sub>OFF</sub>	Power-Off Leakage Current	0	$V_I$ or $V_O = 5.5V$		10	μA
I <sub>CC</sub>	Quiescent Supply Current	2.3–3.6	$V_I = V_{CC}$ or GND		10	μA
			$3.6V \le V_I, V_O \le 5.5V^{(5)}$		±10	
Δl <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	2.3-3.6	$V_{IH} = V_{CC} - 0.6V$		500	μΑ

#### Note:

5. Outputs disabled or 3-STATE only.

#### **AC Electrical Characteristics**

			$T_A = -40$ °C to +85°C, $R_L = 500\Omega$					
		$\label{eq:VCC} \begin{array}{c} \textbf{V}_{\textbf{CC}} = \textbf{3.3V} \pm \textbf{0.3V}, \\ \textbf{C}_{\textbf{L}} = \textbf{50pF} \end{array}$		$egin{aligned} \mathbf{V_{CC}} &= \mathbf{2.7V,} \\ \mathbf{C_L} &= \mathbf{50pF} \end{aligned}$		$\label{eq:CC} \begin{split} V_{CC} = 2.5 V \pm 0.2 V, \\ C_L = 30 pF \end{split}$		
Symbol	Parameter	Min.	Max.	Min.	Max.	Min.	Max.	Units
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay, Data to Output	1.5	6.5	1.5	7.5	1.5	7.8	ns
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	1.5	8.0	1.5	9.0	1.5	10.0	ns
$t_{PLZ}$ , $t_{PHZ}$	Output Disable Time	1.5	7.0	1.5	8.0	1.5	8.4	ns
toshl, toslh	Output to Output Skew <sup>(6)</sup>		1.0					ns

#### Note:

6. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

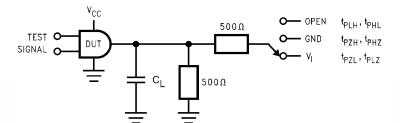
# **Dynamic Switching Characteristics**

				$T_A = 25^{\circ}C$	
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	Typical	Unit
V <sub>OLP</sub>	Quiet Output Dynamic Peak V <sub>OL</sub>	3.3	$C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V$	0.8	V
		2.5	$C_L = 30pF, V_{IH} = 2.5V, V_{IL} = 0V$	0.6	
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	3.3	$C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V$	-0.8	V
		2.5	$C_L = 30pF, V_{IH} = 2.5V, V_{IL} = 0V$	-0.6	

# Capacitance

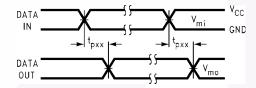
Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	$V_{CC} = Open, V_I = 0V \text{ or } V_{CC}$	7.0	pF
C <sub>OUT</sub>	Output Capacitance	$V_{CC} = 3.3V$ , $V_I = 0V$ or $V_{CC}$	8.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance	$V_{CC} = 3.3V$ , $V_I = 0V$ or $V_{CC}$ , $f = 10MHz$	25.0	pF

#### AC Loading and Waveforms (Generic for LCX Family)

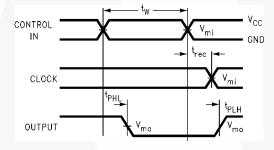


Test	Switch
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
$t_{PZL}, t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH},t_{PHZ}$	GND

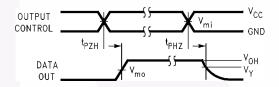
Figure 1. AC Test Circuit (C<sub>L</sub> includes probe and jig capacitance)



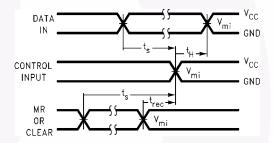
#### **Waveform for Inverting and Non-Inverting Functions**



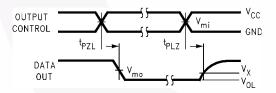
Propagation Delay. Pulse Width and t<sub>rec</sub> Waveforms



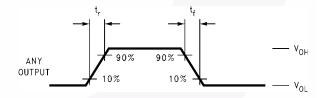
3-STATE Output High Enable and Disable Times for Logic



Setup Time, Hold Time and Recovery Time for Logic



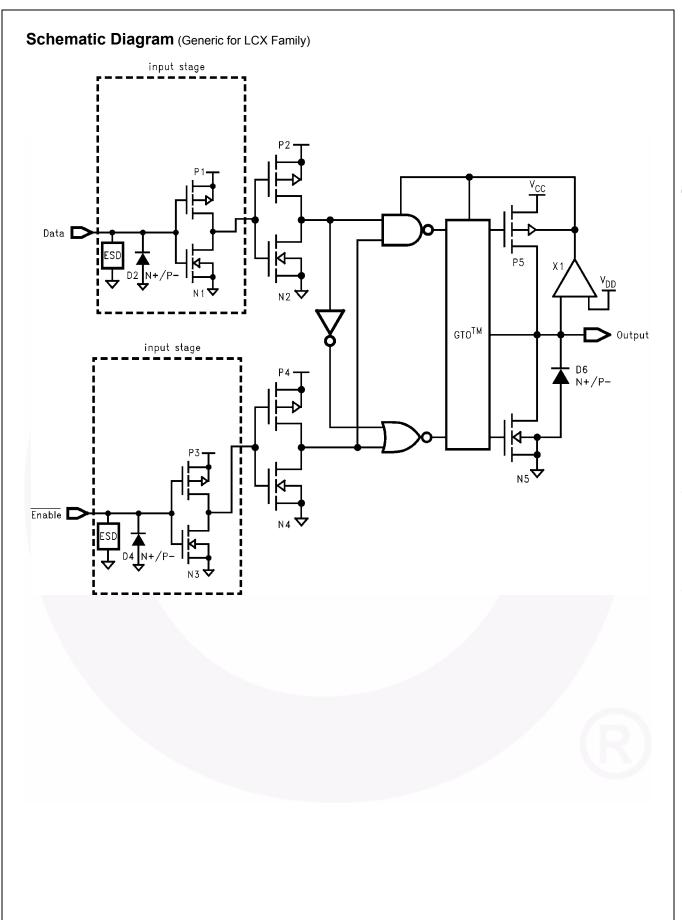
3-STATE Output Low Enable and Disable Times for Logic



t<sub>rise</sub> and t<sub>fall</sub>

	V <sub>CC</sub>				
Symbol	$3.3V \pm 0.3V$	2.7V	2.5V ± 0.2V		
$V_{mi}$	1.5V	1.5V	V <sub>CC</sub> /2		
V <sub>mo</sub>	1.5V	1.5V	V <sub>CC</sub> /2		
V <sub>x</sub>	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.15V		
V <sub>y</sub>	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.15V		

Figure 2. Waveforms (Input Characteristics; f = 1MHz,  $t_r = t_f = 3ns$ )

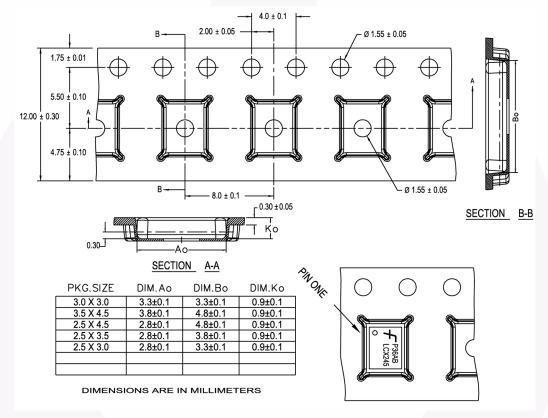


# **Tape and Reel Specification**

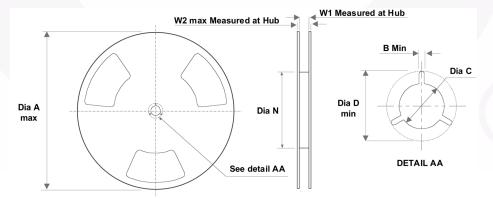
#### **Tape Format for DQFN**

Package Designator	Tape Section	Number of Cavities	Cavity Status	Cover Tape Status	
BQX	Leader (Start End)	125 (typ.)	Empty	Sealed	
	Carrier	3000	Filled	Sealed	
	Trailer (Hub End)	75 (typ.)	Empty	Sealed	

#### Tape Dimension inches (millimeters)



#### Reel Dimensions inches (millimeters)



Tape Size	Α	В	С	D	N	W1	W2
12mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

#### **Physical Dimensions** 13.00 12.60 11.43 В 9.50 10.65 7.60 10.00 7.40 2.25 10 0.51 1.27 PIN ONE 1.27 0.35 **INDICATOR** ⊕ 0.25 M C B A LAND PATTERN RECOMMENDATION 2.65 MAX SEE DETAIL A 0.33 0.20 0.30 0.10 0.75 X 45° **SEATING PLANE** NOTES: UNLESS OTHERWISE SPECIFIED (R0.10) A) THIS PACKAGE CONFORMS TO JEDEC **GAGE PLANE** MS-013, VARIATION AC, ISSUE E (R0.10) B) ALL DIMENSIONS ARE IN MILLIMETERS. 0.25 C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS. D) CONFORMS TO ASME Y14.5M-1994 1.27 0.40 SEATING PLANE E) LANDPATTERN STANDARD: SOIC127P1030X265-20L -(1.40)F) DRAWING FILENAME: MKT-M20BREV3 **DETAIL A** SCALE: 2:1

Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

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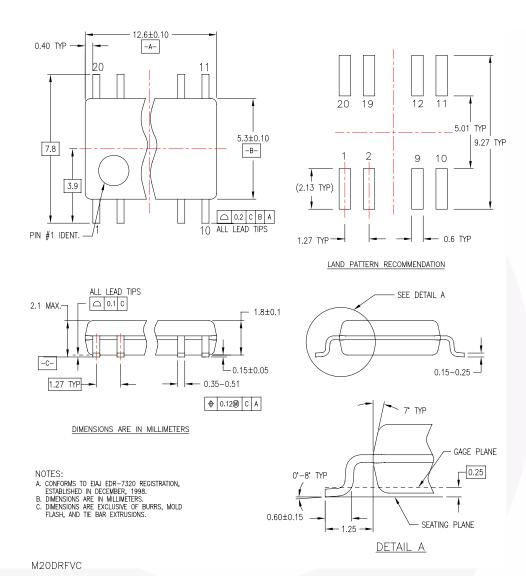
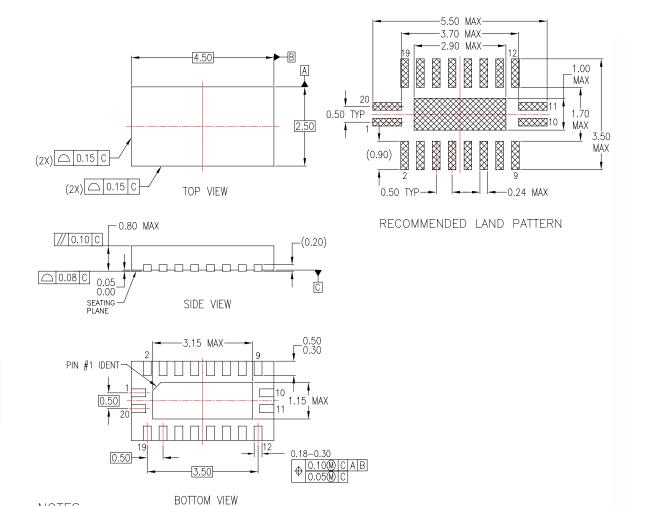


Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

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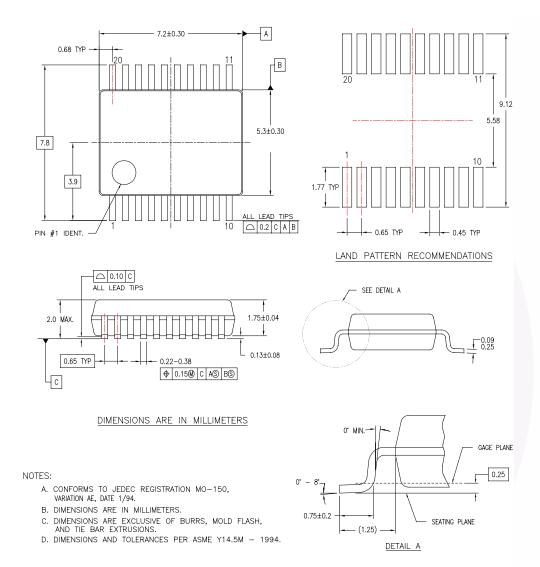
- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AC
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP20BrevA

NOTES:

#### Figure 5. 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm

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MSA20RFVB

Figure 6. 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide

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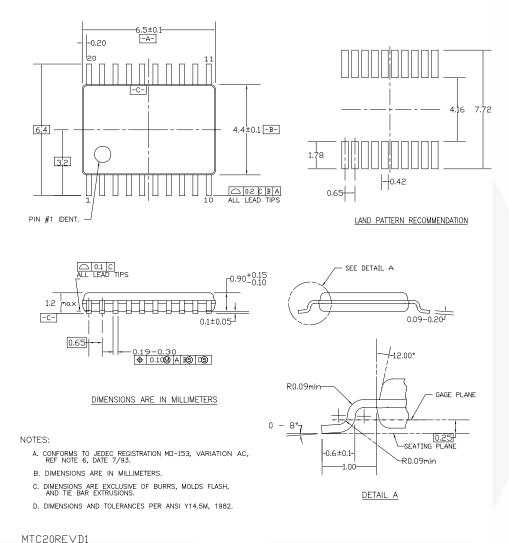


Figure 7. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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